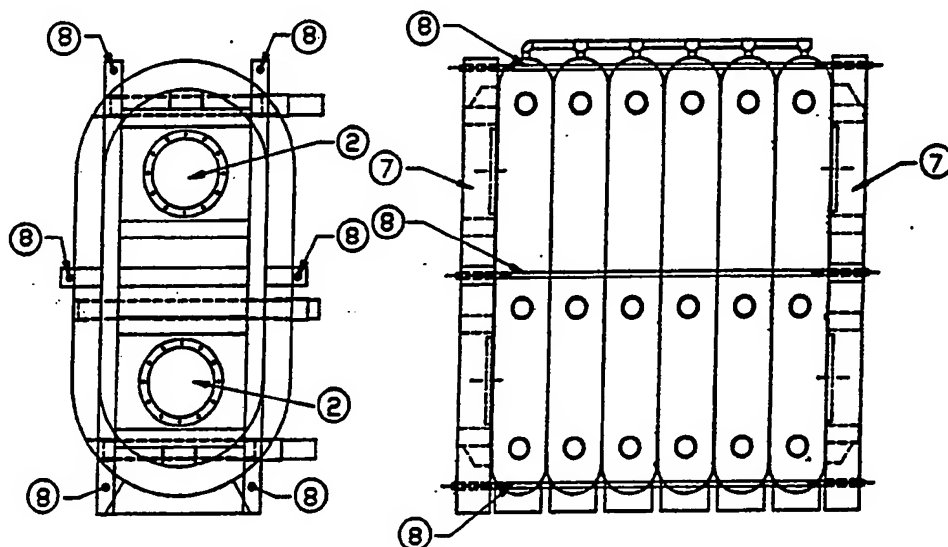




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(54) Title: MODULAR PLASTICS PRESSURE VESSEL**(57) Abstract**

The invention implies a rectangular modular pressure vessel made of glass fiber reinforced vinyl-ester. To avoid destruction of the material due to flat surfaces and perpendicular flanges the vessel wall is constructed as a combination of cylindrical and spherical surfaces enclosed by flat front surfaces held together by steel main heads and bars.

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MODULAR PLASTICS PRESSURE VESSEL

The invention relates to an improved version of a pressure vessel, designed primarily for liquid filtration, and which can be brought to a desired size by integrating loose compartments. Placement in a rectangular space has been one basis for its design.

The renovation or replacement of pressure vessels already installed is often a difficult operation. Certainly if the installation of the old vessel has been effected during building, and such a bulky object cannot pass through a door or window. Removing the old vessel in parts and building a new vessel in situ is a solution for this. Such a so-called modular construction is already known, but owing to its rectangular configuration with flat walls (see, e.g., patent O 049 930 E) this has only proved possible executed in metal. A metal construction has the disadvantage of having a poor corrosion resistance relative to plastics. But a similar construction in plastics requires elaborate steel bracing, if the same design is maintained. Increasing the capacity or specific applications often require a compact construction in a cubical or rectangular shape. This shape involves, if flat plates are used, that great deformation and moment forces occur, resulting in leakage and too low a permissible pressure. By providing elaborate steel structures this can be counteracted. For plastics vessels, this implies an unduly extensive steel structure for supporting purposes. The invention aims to provide a design which experiences virtually no deformation at higher pressures, and a minimum of supporting steel structures. Another object of the invention is a higher operating pressure than conventional constructions in plastics. The dimensions of the cells for a modular structure can be selected so that these can at all times pass through a normal doorway.

Figure 1 is an example of a possible construction of a loose compartment or module, in which Fig 1a illustrates the front-elevational view or the front, and 1b the vertical side-elevational view and 1c the rear view, and 1 d the top plan view. Each loose module has a closed front (1) with openings (2) therein for possible inspection or other functions. The rear wall (3) is virtually entirely open and just consists of a flat flange which forms the adhesive or connecting surface with the front face of the next module or, if there is no next module, it is closed with a flat plate. To prevent bending forces, the vertical side-

walls (4) are made round with a radius (5) equal to half the span between the front face and the rear face. The corners formed by the vertical sidealls and the top and bottom walls are rounded with a radius 5) at least equalling half the distance between front and back; also, the transition from front to back is of round shape with a radius (6) equalling half the distance between front and back. So the corners are of convex shape. A complete pressure vessel consists of an array of at least one module according to Fig. 1, which are connected by means of glued joints, where the front faces (1) form compartments communicating with each other through the openings (2).

Figure 2 represents a possible composition of a plurality of modules, in which a front-elevational view (front) is shown on the left, and a side-elevational view on the right. The front and the back of the respective first and last modules are reinforced with steel bulkheads (7). To prevent the unit from expanding accordion-wise, the steel bulkheads are kept together with tierods (8). In the side and top walls apertures or connections may be made for drains or fittings.

C L A I M S

1. A plastics compartment which, by coupling a certain number of these compartments together (held together by two bulkheads (7) and tierods (8)), can form a closed pressure vessel, for example, for liquid filtration.
2. A plastics compartment as claimed in claim 1, characterized in that the vertical sidealls (4) of said compartment are made round with a radius equalling half the distance between the front back face of this compartment.
3. A plastics compartment as claimed in claims 1 and 2, characterized in that the horizontal top and bottom are made round with a radius equalling half the distance between the front back face of this compartment.
4. A plastics compartment as claimed in claims 1, 2 and 3, characterized in that, in the corners of this compartment, the connection of the two fronts is made round with a radius (5) equalling half the distance between these fronts, and further in which the horizontal and vertical wall is rounded with a radius (6) at least equalling half the distance between the front.
5. A plastics compartment as claimed in claims 1,2,3, and 4, characterize in that the front end is closed with a flat plate.
6. A plastics compartment as claimed in claims 1,2,3,4 and 5, characterized in that, in the closed front, openings (2) may have been made for inspection or for other functional purposes.
7. A plastics compartment as claimed in claims 1,2,3,4,5 and 6 characterized in that the open side of the compartment is provided with a flat flange (3) which by means of a glued joint may be integrated with the closed front of the adjoining compartment or the end bulkhead.

8. A plastics compartment as claimed in claims 1,2,3,4,5,6 and 7, characterized in that a plurality of these compartments can be coupled together, by means of a glued, riveted, or bolted joint, to be extended to a desired size.

9. An assembly of compartments as claimed in claim 8, characterized in that these are held together with two metal bulkheads (7) and tierods (8).

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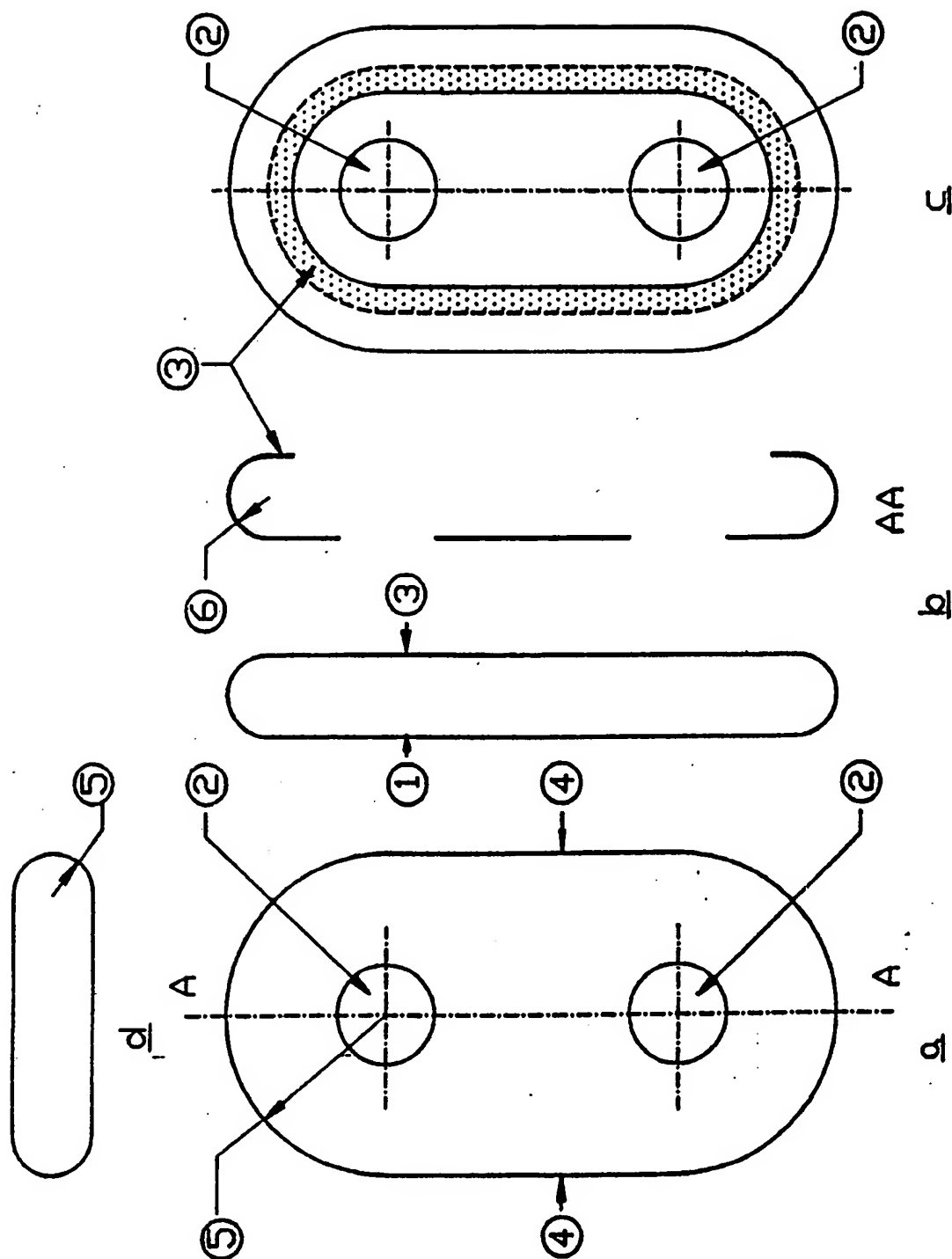


Fig. 1

2/2.

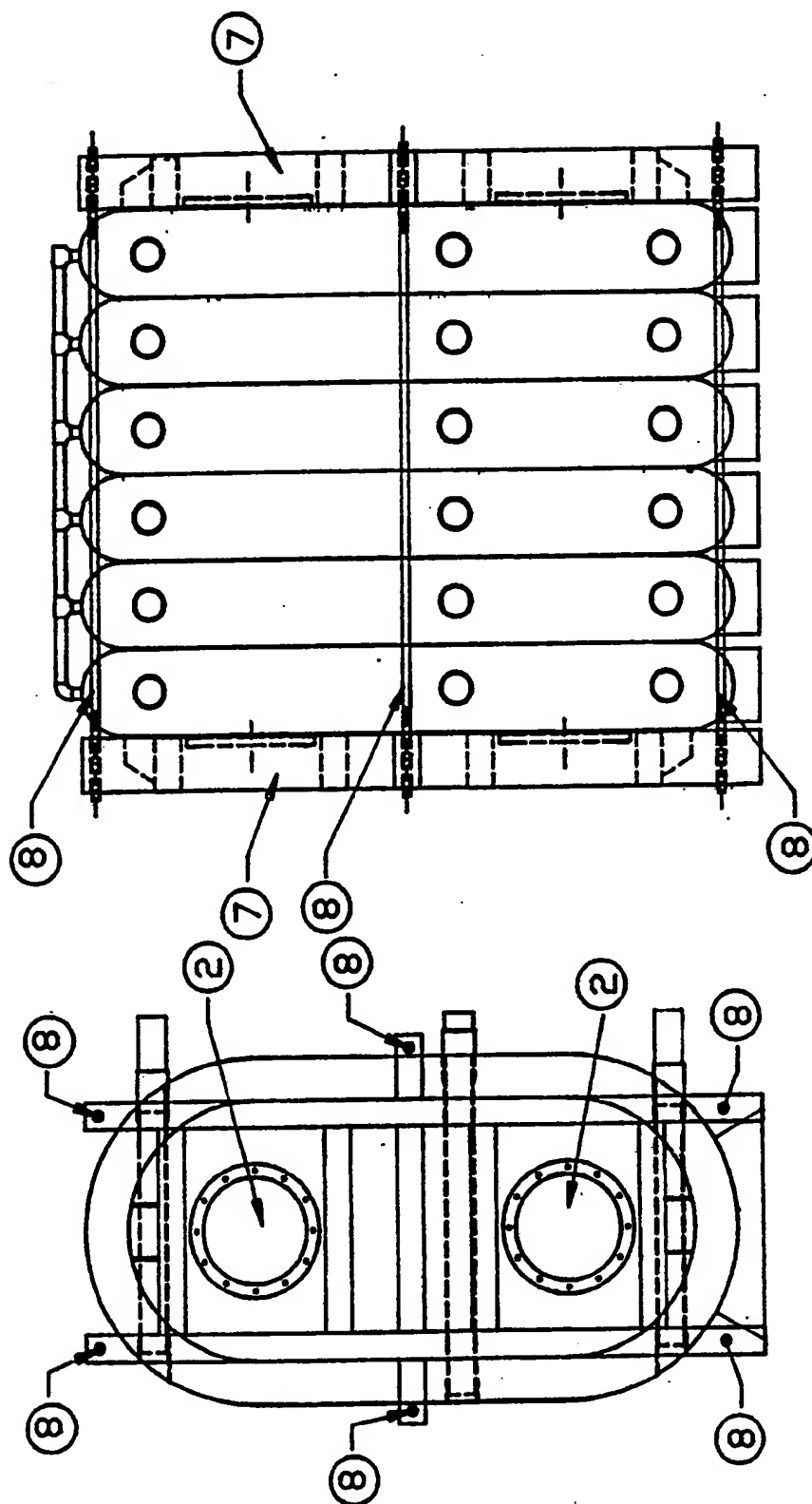


Fig. 2

INTERNATIONAL SEARCH REPORT

International Application No PCT/NL 89/00006

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁴ According to International Patent Classification (IPC) or to both National Classification and IPC IPC ⁴ : B 01 D 35/30																													
II. FIELDS SEARCHED <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Minimum Documentation Searched ⁷</div> <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 30%; border-bottom: 1px solid black;">Classification System</th> <th style="width: 70%; border-bottom: 1px solid black;">Classification Symbols</th> </tr> <tr> <td style="border-right: 1px solid black; padding: 5px;">IPC⁴</td> <td style="padding: 5px;">B 01 D; B 65 D</td> </tr> </table> <div style="text-align: center; border-top: 1px solid black; border-bottom: 1px solid black; margin: 5px 0;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸</div>			Classification System	Classification Symbols	IPC ⁴	B 01 D; B 65 D																							
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III. DOCUMENTS CONSIDERED TO BE RELEVANT ⁹ <table style="width: 100%; border-collapse: collapse;"> <tr> <th style="width: 10%; border-bottom: 1px solid black;">Category ⁹</th> <th style="width: 60%; border-bottom: 1px solid black;">Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²</th> <th style="width: 30%; border-bottom: 1px solid black;">Relevant to Claim No. ¹³</th> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">DE, A, 2360539 (KORDON CORP.) 3 October 1974, see page 3, lines 22-32; page 4; page 5, lines 1-6; figures 1,2</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1,5,6,8</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="text-align: center; vertical-align: top; padding: 5px;">--</td> <td style="text-align: center; vertical-align: top; padding: 5px;">2</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">X</td> <td style="padding: 5px;">DE, A, 2600994 (KIESCHNICK) 14 July 1977, see figure 10; page 10, lines 1-4</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="text-align: center; vertical-align: top; padding: 5px;">--</td> <td style="text-align: center; vertical-align: top; padding: 5px;">2,3,4,9</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">DE, A, 1559149 (DYCKERHOFF & WIDMANN) 25. September 1969, see page 4, lines 10-15; pages 5,6</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1-6,9</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="text-align: center; vertical-align: top; padding: 5px;">US, A, 4588106 (R.G. STARK) 13 May 1986</td> <td style="text-align: center; vertical-align: top; padding: 5px;">--</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="text-align: center; vertical-align: top; padding: 5px;">NL, A, 7312477 (WIVA) 12 March 1975</td> <td style="text-align: center; vertical-align: top; padding: 5px;">--</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">CA, A, 952449 (WONG) 6 August 1974</td> <td style="text-align: center; vertical-align: top; padding: 5px;">----</td> </tr> </table>			Category ⁹	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³	X	DE, A, 2360539 (KORDON CORP.) 3 October 1974, see page 3, lines 22-32; page 4; page 5, lines 1-6; figures 1,2	1,5,6,8	A	--	2	X	DE, A, 2600994 (KIESCHNICK) 14 July 1977, see figure 10; page 10, lines 1-4	1	A	--	2,3,4,9	A	DE, A, 1559149 (DYCKERHOFF & WIDMANN) 25. September 1969, see page 4, lines 10-15; pages 5,6	1-6,9	A	US, A, 4588106 (R.G. STARK) 13 May 1986	--	A	NL, A, 7312477 (WIVA) 12 March 1975	--	A	CA, A, 952449 (WONG) 6 August 1974	----
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<div style="display: flex; justify-content: space-between;"> <div style="width: 45%;"> <p>¹⁰ Special categories of cited documents: ¹⁰</p> <p>"A" document defining the general state of the art which is not considered to be of particular relevance</p> <p>"E" earlier document but published on or after the international filing date</p> <p>"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)</p> <p>"O" document referring to an oral disclosure, use, exhibition or other means</p> <p>"P" document published prior to the international filing date but later than the priority date claimed</p> </div> <div style="width: 45%;"> <p>"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention</p> <p>"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step</p> <p>"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.</p> <p>"G" document member of the same patent family</p> </div> </div>																													
IV. CERTIFICATION <table style="width: 100%; border-collapse: collapse;"> <tr> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;"> Date of the Actual Completion of the International Search <div style="text-align: center;">26th May 1989</div> </td> <td style="width: 50%; border-bottom: 1px solid black; padding: 5px;"> Date of Mailing of this International Search Report <div style="text-align: center;">22. 06. 89</div> </td> </tr> <tr> <td style="border-bottom: 1px solid black; padding: 5px;"> International Searching Authority <div style="text-align: center;">EUROPEAN PATENT OFFICE</div> </td> <td style="border-bottom: 1px solid black; padding: 5px;"> Signature of Authorized Officer <div style="text-align: center;"> P.C.G. VAN-DER PUTTEN </div> </td> </tr> </table>			Date of the Actual Completion of the International Search <div style="text-align: center;">26th May 1989</div>	Date of Mailing of this International Search Report <div style="text-align: center;">22. 06. 89</div>	International Searching Authority <div style="text-align: center;">EUROPEAN PATENT OFFICE</div>	Signature of Authorized Officer <div style="text-align: center;"> P.C.G. VAN-DER PUTTEN </div>																							
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**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO.**

NL 8900006

SA 27274

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report. The members are as contained in the European Patent Office EDP file on 09/06/89. The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
DE-A- 2360539	03-10-74	US-A- 4024064 JP-A- 49122149	17-05-77 21-11-74
DE-A- 2600994	14-07-77	AT-B- 365085 CH-A- 618887	10-12-81 29-08-80
DE-A- 1559149	25-09-69	None	
US-A- 4588106	13-05-86	None	
NL-A- 7312477	12-03-75	AT-B- 337594 BE-A- 819680 CH-A- 581562 DE-A- 2441987 FR-A- 2243117 GB-A- 1468996 JP-A- 50055920 LU-A- 70848 SE-A- 7411347 US-A- 3934747	11-07-77 10-03-75 15-11-76 27-03-75 04-04-75 30-03-77 16-05-75 11-06-75 11-03-75 27-01-76
CA-A- 952449	06-08-74	None	